Anchorage for pre-tensioned and/or stressed tensile elements

The invention relates to an anchorage for at least one pre-tensioned or stressed tensile element, which comprises one or several wedges, an anchor body and a wedge-shaped layer, wherein the tensile force is transmittable to the anchor body by means of the wedge or the wedges and the wedge-shaped layer has a modulus of elasticity that is lower compared to the other parts of the anchorage, and whereby the greatest thickness of the wedge-shaped layer, measured normal to the longitudinal axis of the tensile element, lies in the region of the anchorage which is near the load.

Wedge-anchorages have been used for many years for the pre-tensioning of prestressing steels made of high-strength steel. They are based on a simple principle and can be manufactured with a low expenditure of time and materials. For prestressed concrete constructions, the wedge-anchorage is the most common type of anchorage.

With wedge-anchorages, the force in the tensile element is introduced into the wedges via shearing strains and is passed on from there into the anchor body. Wedges and anchor bodies are in contact via an inclined plane on which the wedges can slide. When the tensile element is loaded, a force of pressure normal to the tensile element is created due to the wedge shape, which force presses the wedges against the tensile element.

Internationally, new types of materials such as fibre composites are increasingly used instead of steel for pre-tensioned or stressed tensile elements such as lamellae, wires, rods or cords. Compared to metallic tensile elements, fibre composites have a very high corrosion resistance and a low weight. A significant disadvantage of fibre composites is their high sensitivity to transverse pressure.

The height of the maximum transmittable shearing strain between the wedge and the tensile element conforms to the contact pressure. The higher the contact pressure, the higher the maximum transmittable shearing strain. The contact pressure produces a transverse pressure in the tensile element. In case of materials which are sensitive to transverse pressure, such as, e.g., fibre composites, the maximum transverse pressure which occurs must not exceed a particular quantity.

In order to activate the shearing strains between the wedge and the tensile element, a minimum amount of slippage is necessary. With a conventional wedge-anchorage, a high contact pressure between the wedge and the tensile element is created in the region near the

load, which contact pressure produces there also a high shearing strain which decays quickly and remains almost constant up to the region remote from the load. The sum of the shearing strains along the entire contact surface between the wedge and the tensile element corresponds to the tensile force in the tensile element. The greatest shearing strain occurs at the site of the maximum contact pressure, where also the largest amount of tensile force per surface unit is transmitted. It is a disadvantage that, from the site of the maximum shearing strain to the region remote from the load, the shearing strain can hardly be activated. Another disadvantage of a conventional anchorage is that the maximum contact pressure and the maximum shearing strain have to be relatively low, since materials such as fibre composites fail under low contact pressures or transverse pressures.

From DE 100 10 564 C1, an anchorage for a tensile element made of a fibre composite is known which is not designed as a wedge-anchorage, but shearing forces are transmitted between the tensile element and an anchor sleeve by an adhesive bond via a casting compound. The anchor sleeve is provided with a profiling with which the forces are transmitted via a gear tooth system.

In WO 95/29308, a conical casting anchorage for fibre composites is described. The anchor sleeve has a conical cavity. Along the direction of the tensile element, the cavity is filled in sections with a casting compound having different moduli of elasticity. In the section on the region near the load, a casting compound with the lowest modulus of elasticity is inserted. In the subsequent sections up to the region remote from the load, casting materials with ever increasing moduli of elasticity are used. In this way, a more uniform transmission of power from the tensile element to the casting body is achieved. However, the manufacture of these layers is a complex process.

EP 0 197 912 A2 discloses an anchorage for prestressing elements of the initially described kind which are made of high-strength steel, wherein the anchor body is composed of two layers of different materials such as a synthetic material or a soft metal. The layer made of a softer material is designed with a constant thickness across the entire wedge length or with a layer which is variable across the wedge length but has the smallest thickness in the region near the load. If the tensile element is loaded, high transverse pressure peaks occur in the region near the load. Materials sensitive to transverse pressure, such as fibre composites, are unable to withstand these high transverse pressures and hence fail prematurely.

In EP 0 197 912, a further variant is shown according to which two wedges lying one after the other in the longitudinal direction of the tensile element are provided in a one-piece

anchor body, wherein the wedge closer to the load is formed by a pressed piece which is softer than the tensile element, said wedge-shaped pressed piece having its greatest thickness in the region near the load. The wedge more remote from the load is designed as an anchor wedge and has its greatest thickness in the region remote from the load so that thereby stress peaks and thus transverse pressure peaks occur at the tensile element.

(the original pages 3 to 10 follow)

Claims:

1. An anchorage (7) for at least one pre-tensioned or stressed tensile element (1), which comprises one or several wedges (3), an anchor body (2) and a wedge-shaped layer (22, 32, 34), wherein the tensile force is transmittable to the anchor body (2) by means of the wedge or the wedges (3) and the wedge-shaped layer (22, 32, 34) has a modulus of elasticity that is lower compared to the other parts of the anchorage (7), and whereby the greatest thickness of the wedge-shaped layer (22, 32, 34), measured normal to the longitudinal axis (4) of the tensile element (1), lies in the region (5) of the anchorage (7) which is near the load, characterized in that the wedge (3) and/or the anchor body (2) is/are formed at least by two wedge-shaped adjacent layers (21, 22, 31, 32), with at least one of the layers (22, 32, 34) being formed from a material having a lower modulus of elasticity than the material from which the further layer(s) of the wedge (3) and/or of the anchor body (2) is/are formed, and the greatest thickness of said layer (22, 32, 34) is provided in the region near the load.

2. The anchorage (7) according to claim 1, characterized in that, in the layer (22, 32, 34) having a lower modulus of elasticity, pores, holes, notches or slots reducing the stiffness of said layer normal to the longitudinal axis (4) of the tensile element (1) are arranged.

3. The anchorage (7) according to claim 1 or 2, characterized in that the different moduli of elasticity of the individual layers (21, 22, 23, 31, 32, 33, 34) are caused during their manufacture by means of specific treatments such as heating or cooling processes.

4. The anchorage (7) according to one or several of claims 1 to 3, characterized in that the anchor body (2) as a coupling for two tensile elements (1) is provided with seats for wedges (3), which seats are oriented opposite to each other.

5. The anchorage (7) according to one or several of claims 1 to 4, characterized in that the layer (22, 32, 34) having a lower modulus of elasticity is connected to the layer (31, 21) having a higher modulus of elasticity via a non-positive and/or positive connection such as a profile with a counterprofile, e.g., a gear tooth system, and/or by adhesive bonding.

6. The anchorage (7) according to one or several of claims 1 to 5, characterized in that a transmission of shearing force between the wedge (3) and the tensile element (1) is ensured by a non-positive connection and/or by form closure, such as, e.g., by friction, adhesive bonding or the shaping of a profile, e.g., by gearing with counter gear teeth.

(the original pages 12 and 13 follow)